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ASH SAMPLING METHODS AT THREE ONTARIO ENERGY FROM WASTE (EFW) PLANTS AS PART OF THE NATIONAL INCINERATOR TESTING AND EVALUATION PROGRAM

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Foreword

All methods of ash sampling described in this paper were chosen to produce a representative sample at the individual plant. This was likely achieved in the case of fly ashes but was less likely to have occurred in the case of bottom ash because of the variation in composition and size of the ash.

Bottom ash is the unburned material remaining in the incinerator after burning a municipal waste. Fly ash is the fine material removed from the combustion gases. Relative particle size of the waste being sampled dictates the ease of sampling, that is, fly ash is relatively easy to sample, while bottom ash is more difficult.

Trade-offs were evaluated in sample methodology and in the case of bottom ash, simplicity was a significant factor. All methods were selected to obtain as representative a field sample as possible. Lab methods for mixing and sample size reduction are not described herein.

Executive Summary

This report describes ash sampling techniques used in Ontario at three Energy-From-Waste plants as part of a program to investigate the character of the ash. Methodologies differed at each plant due to differences in the incineration process, process equipment, pollution control equipment, plant layout and available sampling ports.

Also a short description of each plant is given, along with problems encountered and recommended changes to sampling proceedure.

The ash sampling techniques were mainly developed by the ash specialist of the MOEE's Waste Management Branch.

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Introduction

The National Incinerator Testing and Evaluation Program (NITEP) was established by Environment Canada as a research program. It investigated emissions from Energy-from-Waste (EFW) plants in order to assess the various incineration technologies in place. The program included ash sampling and characterization.

This report describes the ash sampling techniques used in the Ontario portion of the programs during 1988 and 1989, as participated in by the representative from the Ministry of the Environment's Waste Management Branch.

In the initial NITEP project in Prince Edward Island it was found that in order to sample without causing system disruptions, major modifications had to be made to the plant. In the case of ash sampling, modifications were made to the quench tank hood (the installation of a capped port) and the boiler outlet hopper (special extension replacement of the hopper bottom). Since the bottom ash discharged from all three incineration units to a common trough, separation into 3 separate streams, although desirable, was considered to be unjustified in view of excessive potential costs.

At Quebec City, the second NITEP project, major modifications to the incinerator allowed some sampling ports to be "designed in". Again, however, it was not possible to separate the four bottom ash streams to measure separate discharge rates.

Ontario Sampling

SWARU

The SWARU (Solid **WA**ste **R**eduction **U**nit) plant in Hamilton consists of two water wall boilers burning shredded refuse derived fuel in suspension with final burnout taking place on a travelling grate. During the course of the sampling period one of the boilers was shut down for scheduled maintenance.

Bottom Ash

Bottom ash was removed directly from the centre portion of the discharge end of the travelling grate prior to quenching in the water bath. Grab samples were taken approximately every twenty minutes, (but only when the plant was at normal operating conditions as advised by the control room) over a five hour period (four hour run).

This was accomplished by opening the middle observation door of the boiler and inserting a shovel with a twelve foot long handle into the ash bed. Due to the weight of the shovel this meant being in close proximity to the open door of the boiler, making the use of high temperature gloves, cotton or non-flammable coveralls and head and neck protection necessary safety features. An aluminized high temperature hood with a "gold glass" face shield was used by the sampler for protection when the incinerator developed a positive interior pressure and blew flame out through the open door.

The ash sample was immediately transferred to a new 45 gallon drum. The interior of this drum did not visually appear to be coated (coatings may contaminate the sample) and the drum was cleaned with tap water and allowed to dry by the boiler prior to use. The drum contained dry ice to quench any remaining combustion.

The drum was half filled during the 4 hour sampling period and at the end of the test the contents of the drum were "rough mixed" by rolling the sealed drum to the sample preparation area.

The contents of the drum were tipped onto a clean concrete floor and mixed with a shovel using a long pile technique as described below.

Ash was spread thinly from a shovel for about six feet in a straight line. A second shovel full was then spread over the first. This continued until the container was empty. The ash was then turned over i.e. the end of the pile was dug into and moved two spade widths away from the end of the pile with the top becoming the bottom and vice versa. A second shovel full was then removed and placed next to the first. This continued until the whole pile had been relocated by two spade widths and turned over.

This procedure was then continued, moving the pile back to the original position.

After the sampling expert decided that adequate mixing had taken place, i.e. when the pile appeared to be uniformly mixed, in this case after 4 turnovers, the ash was piled in a cone and then flattened to about 4 inches in depth.

The pile was then divided into four quarters using a steel strip. Diagonally opposite quarters were then combined and one pile discarded on a random basis determined by a coin toss. The remainder was mixed, coned and quartered again. This was repeated until the sample would fit in a clean 5 gallon steel pail as required by the laboratory.

Fly Ash

Fly ash was diverted from the fly ash conveyor (prior to the pug mill) into 45 gallon drums at twenty minute intervals (approximately 15-20 drums over a 4 hour test period), approximately half a drum being filled on each occasion. At the end of the test, each drum of fly ash was cored using a one inch diameter by 4 ft long "T" handled soil sampler and also a two inch diameter by 4 ft long tube. The latter was more successful because by capping the top end of the tube with the palm of a hand the core would stay in the tube. The "T" handle allowed air to enter the tube through both ends of the handle and the core would slide out. All cores (3 - 4 cores per drum) were placed in 5 gallon steel pails for transportation to the laboratory.

Victoria Hospital, London

The Victoria Hospital Energy-from Waste facility provides steam and electricity to the various buildings of the hospital complex. It consists of 3 parallel mass burn two stage modular combustion units, each designed to handle 75 to 90 tonnes of municipal solid waste per day. No commercial, pathological or other biomedical waste is processed in the facility.

Bottom Ash

Hourly samples of bottom ash were taken from the top of the most recent pile of ash in the roll-off container. This container received ash from only the incinerator unit being sampled. The ash chute was first moved so that new ash would not fall in the direction of the sampler. (Large pieces of metal such as automobile steel tire rims, are a hazard when they drop into the ash container). A shovel with a small blade (approximately 6" x 6") produced a full five gallon steel pail every 24 hours (one shovel full per hour). Coning and quartering took place at the CCIW (Canada Centre for Inland Waters) laboratory.

Fly Ash

Fly ash from the conditioning tower and baghouse was obtained by running the ash screw conveyors once every eight hours. All of the ash was retained for subsequent sampling. The ash was diverted through a specially installed sample port into 45 gallon drums, two to three drums being filled per shift. Each drum was then sampled using a two inch tube sampler to the full depth of the drum with cores being evenly spaced around the drum. The same number of cores from each drum were used to form a composite sample.

An attempt was made to sample boiler and economizer ash from the drop chutes on a daily basis. However, double gates had not been installed and collected material was 'sucked back' by the system vacuum on opening the single gate. Samples were obtained at the end of five days when sufficient material had built up to form a pneumatic seal.

3M London

The 3M Waste to Energy Facility can produce up to 90% of the steam required by the plant. It uses in-plant waste such as pallets, plastic wrapping, scrap cardboard and paper as well as off specification products such as tape and abrasive cloth and paper. The plant also accepts similar material from other industries. The plant uses solvent laden exhaust from the tape process oven as make up air, removing a plant odour problem.

The plant is a two stage combustion mass burn facility with a rotary kiln primary that uses coarsely shredded waste as fuel.

Bottom Ash

Bottom ash was taken from the discharge end of the kiln every 30 minutes over a period of 5 hours as the ash dropped towards the quench tank. A special sampler had been designed for this, but it was subsequently modified (i.e. made smaller). It's installation on the opposite side of the discharge chute than had been originally intended necessitated entering the quench tank pit (following confined space entry procedures), standing on a step ladder and still having to take hot ash samples from above head height. The insulated 'fibreglass' gloves used to hold the sampler were ruined by the high temperature of the sampler after it had been left in place for about two minutes longer than normal to obtain additional sample. The hot ash was placed in a 5 gallon steel pail containing dry ice to quench any remaining combustion. A partially full pail was obtained for each test period and then shipped to the laboratory.

This technique is not acceptable and needs to be changed to protect the person doing the sampling. Of particular importance is to ensure that the sampling location be in the proper position relative to the discharge chute.

Fly Ash

Fly ash samples from the boiler and economizer were obtained by not running the discharge screw conveyors during the 5 hour test period, thus allowing the ash to build up in the hoppers. The conveyors were then "locked out", the tops removed and the ash pulled off the screw flights by hand. The conveyors were then restarted for a few seconds to move more ash into the open section and then relocked out. Sampling then proceeded in this manner until sufficient sample was obtained (half pail). This was not very successful and proper sampling ports were suggested to the plant operator.

It would appear that no significant boiler ash was produced during the course of the test period. One sample was obtained by banging on the hopper sides with a large hammer and may have resulted in obtaining a sample of previous ash build-up. Lack of boiler ash during the operation may be attributed to non deposition in the boiler (suspected due to high gas velocities).

The baghouse sample was collected by taking a plate off one of the rotary valves in the pneumatic transfer line and diverting the ash-lime mixture into a container hung under the pipe.

Equipment

The following is a list of equipment that was used during the NITEP ash sampling program in Ontario.

- Hard hats
- Steel toed boots
- Coveralls with long sleeves (1 cleaned pair/person/day + a spare). If bottom ash samples are to be taken prior to quenching the coveralls should be made of treated cotton or nomex (i.e. non-flammable).
- Gloves. Both cotton and rubber should be available (1 cleaned pair/person/day + spares). High temperature gloves or mitts if sampling bottom ash prior to quenching.
- Dust Masks. Disposable or cartridge type (depending on plant regulations).
- Hood. Aluminized with reflective face shield if risk of flame blowback exists when taking bottom ash samples directly from the grate.
- Hearing protectors (insertion type).
- Eye protection. Safety glasses with either goggles or full face shield
- Flashlights
- Tools: Shovels, wire cutters, tin snips, pliers, pipe wrenches, hammers, etc.
- Sample containers: Glass and/or PET wide mouth jars, with suitable cap liners, 5 gallon pails, 45 gallon drums (detachable head) (the pails and drums should be steel and should not be painted or otherwise coated on their interior)
- Weigh scale of 200 kg capacity
- Steel strip for quartering sample (3' x 4" x 1/8")
- Tube samplers for fly ash (2" diameter x 4')
- Steel scoops
- Small brush
- Pipe thread tape (PTFE)
- Note books, pens, pencils, labels, adhesive tape, permanent markers for glass, etc.
- Appropriate sample request forms, etc.